

REMARKS

This is in full and timely response to the non-final Office Action mailed on March 27, 2002. Reexamination in light of the amendments and the following remarks is respectfully requested.

Claims 1-45 are currently pending in this application, with claims 1 and 23 being independent.

No new matter has been added.

Restriction

The election of January 22, 2002 includes an election of method claims 1-22, with traverse. Only claims 1, 2, 8, 9, 14, 16, 17, 20 and 21 have been examined. Claims 3-7, 10-14, 15, 18 and 22 have been improperly withdrawn from consideration as drawn to a non-elected invention.

Thus, the non-final Office Action is incomplete at least for this reason. See M.P.E.P. §707.07, 8th Edition, August 2001. A new non-final Office Action is respectfully requested.

A Petition Under 37 C.F.R. §1.144 has been filed along with this Request for Reconsideration. Please have this Petition considered in a timely manner.

Rejections under 35 U.S.C. 112

Claims 16-17 were rejected under 35 U.S.C. 112, second paragraph.

This rejection is traversed at least for the following reasons.

The Office Action contends that claim 16 feature of a temperature within a range of 800 to 2000° C and lower than its melting point, lacks clarity.

As a rule, "for claim construction purposes, the description may act as a sort of dictionary, which explains the invention and may define terms used in the claims." *General Electric Co. v. Nintendo Co.*, 50 USPQ2d 1910, 1914 (Fed. Cir. 1999).

The specification as originally filed, at for example, page 13, lines 7-9, provides that the catalyzer is heated to a temperature within a range of 800 to 2000° C and lower than the melting point. Page 13, lines 14-20 of the specification further provides that:

If the heating temperature of the catalyzer is lower than 800° C, the catalytic reaction or thermal decomposition of the reaction gas is insufficient and the deposition rate tends to be lowered. If the heating temperature exceeds

2000° C, the component material of the catalyzer is mixed into the deposited film, thus hindering the electrical property of the film and deteriorating the quality of the film. The heating to the melting point of the catalyzer or higher should be avoided since it causes loss of shape stability. The heating temperature of the catalyzer is preferably lower than the melting point of the component material and 1100 to 1800° C.

Withdrawal of this rejection and allowance of the claims is respectfully requested.

Rejections under 35 U.S.C. 103

Claims 1, 2, 16, 17 and 20 were rejected under 35 U.S.C. 103 as being allegedly obvious over U.S. Patent No. 6,225,241 issued to Miyoshi in view of U.S. Patent No. 4,668,365 issued Foster.

Claims 8 and 9 were rejected under 35 U.S.C. 103 as being allegedly obvious over Miyoshi in view of Foster and in further view of U.S. Patent No. 6,291,343 issued to Teng et al. (Teng).

Claim 14 was rejected under 35 U.S.C. 103 as being allegedly obvious over Miyoshi in view of Foster and in further view of U.S. Patent No. 5,900,161 issued to Doi.

Claim 21 was rejected under 35 U.S.C. 103 as being allegedly obvious over Miyoshi in view of Foster and in further view of

U.S. Patent No. 3,769,670 issued to Schrank.

These rejections are respectfully traversed for at least the following reasons.

Within the claimed invention, 1, *inter alia*, a reaction gas is brought into contact with a heated catalyzer and an electric field of not higher than a glow discharge starting voltage.

The Office Action admits that Miyoshi fails to disclose, teach or suggest the claimed electric field. Thus, Miyoshi fails to disclose, teach or suggest a reaction gas brought into contact with a heated catalyzer and an electric field of not higher than a glow discharge starting voltage. The Office Action cites Foster for the features deficient within Miyoshi.

Note initially, there is no teaching within Miyoshi or Foster that the apparatus of Foster is suitable for performing the process of Miyoshi. Specifically, there is no teaching within Miyoshi or Foster that the apparatus of Foster is suitable for performing the catalytic CVD process of Miyoshi. For example, note that a catalyzer is nonexistent within Foster. As such, proper motivation to combine the teachings of Foster and Miyoshi is absent.

Moreover, Foster also fails to disclose, teach or suggest an electric field of not higher than a glow discharge starting voltage. Any other interpretation of Foster is mere hindsight. Instead, the Office Action "interprets" low DC bias with Foster as the claimed electric field. Specifically, the Office Action interprets low DC bias with Foster as a voltage that is below the glow discharge starting voltage.

However, please note that a glow discharge starting voltage amount is not taught within Foster. Likewise, an electric field of not higher than a glow discharge starting voltage is also not taught within Foster.

In this regard, the Office Action impermissibly benefits from of the specification to make the necessary changes in Foster. "It is impermissible, however, simply to engage in a hindsight reconstruction of the claimed invention, using the applicant's structure as a template and selecting elements from references to fill the gaps. The references themselves must provide some teaching whereby the applicant's combination would have been obvious" (citations omitted). *In re Gorman*, 18 USPQ2d 1885, 1888 (Fed. Cir. 1991). See also *In re Dembiczak*, 50 USPQ2d 1614, 1616 (Fed. Cir. 1999) (rejection based upon hindsight is reversed).

In addition, this assertion amounts to nothing more than an "obvious-to-try" situation. Specifically, "an 'obvious-to-try' situation exists when a general disclosure may pique the scientist's curiosity, such that further investigation might be done as a result of the disclosure, but the disclosure itself does not contain a sufficient teaching of how to obtain the desired result, or that the claimed result would be obtained if certain directions were pursued." *In re Eli Lilly & Co.*, 14 USPQ2d 1741, 1743 (Fed. Cir. 1990). Moreover, "an invention is 'obvious to try' where the prior art gives either no indication of which parameters are critical or no direction as to which of many possible choices is likely to be successful." *Merck & Co. Inc. v. Biocraft Laboratories Inc.*, 10 USPQ2d 1843, 1845 (Fed. Cir. 1989).

Here, Foster does not contain a sufficient teaching of how to obtain the desired result, or that the claimed result would be obtained if certain directions were pursued. "Obvious to try" is not the standard under §103. *In re O'Farrell*, 7 USPQ2d 1673, 1680 (Fed. Cir. 1988).

As a result, Miyoshi and Foster, either individually or as a whole, fail to disclose, teach or suggest a reaction gas brought into contact with a heated catalyzer and an electric field of not higher than a glow discharge starting voltage.

The Office Action cites Teng for the features deficient within Miyoshi and Foster. Note, there is no teaching within Miyoshi, Foster or Teng that the apparatus of Teng is suitable for performing the process of Miyoshi and Foster. Specifically, there is no teaching within Miyoshi, Foster or Teng that the apparatus of Teng is suitable for performing the catalytic CVD process of Miyoshi. For example, note that a catalyzer is nonexistent within Teng. As such, proper motivation to combine the teachings of Miyoshi, Foster and Teng is absent.

As a result, Miyoshi, Foster and Teng, either individually or as a whole, fail to disclose, teach or suggest a reaction gas brought into contact with a heated catalyzer and an electric field of not higher than a glow discharge starting voltage.

The Office Action cites Doi for the features deficient within Miyoshi and Foster. Note, there is no teaching within Miyoshi, Foster or Doi that the apparatus of Doi is suitable for performing the process of Miyoshi and Foster. Specifically, there is no teaching within Miyoshi, Foster or Doi that the apparatus of Doi is suitable for performing the catalytic CVD process of Miyoshi. For example, note that a catalyzer is nonexistent within Doi. As such, proper motivation to combine the teachings of Miyoshi, Foster and Doi is absent.

As a result, Miyoshi, Foster and Doi, either individually or as a whole, fail to disclose, teach or suggest a reaction gas brought into contact with a heated catalyst and an electric field of not higher than a glow discharge starting voltage.

The Office Action cites Shrank for the features deficient within Miyoshi and Foster. Note, there is no teaching within Miyoshi, Foster or Shrank that the method of Shrank is suitable for performing the process of Miyoshi and Foster. Specifically, there is no teaching within Miyoshi, Foster or Shrank that the method of Shrank is suitable for performing the catalytic CVD process of Miyoshi. For example, note that a catalyst is nonexistent within Shrank. As such, proper motivation to combine the teachings of Miyoshi, Foster and Shrank is absent.

As a result, Miyoshi, Foster and Shrank, either individually or as a whole, fail to disclose, teach or suggest a reaction gas brought into contact with a heated catalyst and an electric field of not higher than a glow discharge starting voltage.

Withdrawal of these rejections and allowance of the claims is respectfully requested.

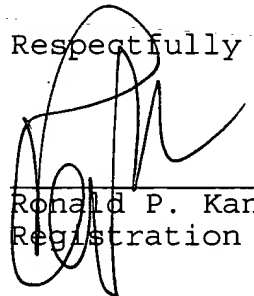
If the allowance of the claims is not forthcoming at the very least, then a new non-final Office Action is respectfully requested.

Conclusion

For the foregoing reasons, all the claims now pending in the present application are allowable, and the present application is in condition for allowance. Accordingly, favorable reexamination and reconsideration of the application in light of the amendments and remarks is courteously solicited.

If the Examiner has any comments or suggestions that could place this application in even better form, the Examiner is requested to telephone Brian K. Dutton, Reg. No. 47,255, at 202-955-8753, or the undersigned attorney at the below-listed number.

Respectfully submitted,



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APPENDIX

IN THE SPECIFICATION

Please replace the paragraph beginning at page 20, line 2 with the following rewritten paragraph.

-- To carry out the DC-bias catalyzed CVD method, the degree of vacuum in the deposition chamber 44 is set at 10^{-6} to 10^{-8} Torr, and the hydrogen-based carrier gas is supplied at 100 to 200 SCCM (standard cc per minute). After the catalyzer is heated to a predetermined temperature for activation, the reaction gas 40 made of the silicon hydride (e.g., mono-silane) gas at 1 to 20 SCCM (including an appropriate quantity of the doping gas made of B_2H_6 , PH_3 or the like, if necessary) is fed from the supply duct 41 through the supply port 43 of the shower head 42, and the gas pressure is set at 10^{-1} to 10^{-3} Torr, for example, 10^{-2} Torr. The hydrogen-based carrier gas may be any gas that is produced by mixing an appropriate quantity of inert gas with hydrogen, for example, hydrogen, hydrogen + argon, hydrogen + helium, hydrogen + neon, hydrogen + xenon, hydrogen + krypton or the like. (This applies throughout the following description.) The hydrogen-base carrier gas is not necessarily required, depending on the ~~typew~~ type of the material gas. That is, there is known a method for forming polysilicon by catalytic reaction of silane alone without using the hydrogen-based carrier gas (known as a hot wire

method), and the present invention can also apply to this method.

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IN THE CLAIMS

1. A film forming method in which a reaction gas is brought into contact with a heated catalyzer and an electric field of not higher than a glow discharge starting voltage is caused to act on the produced reactive species, thereby providing kinetic energy and carrying out vapor growth of a predetermined film on a base.

2. The film forming method as claimed in claim 1, wherein a DC voltage not higher than the glow discharge starting voltage is applied to direct the reactive species toward the base.

3. The film forming method as claimed in claim 1, wherein a voltage not higher than the glow discharge starting voltage and produced by superimposing an AC voltage on a DC voltage is applied.

4. The film forming method as claimed in claim 3, wherein the AC voltage is a high-frequency voltage and/or a low-frequency voltage.

5. The film forming method as claimed in claim 4, wherein the high-frequency voltage has a frequency of 1 MHz to 10 GHz and the low-frequency voltage has a frequency less than 1 MHz.

6. The film forming method as claimed in claim 1, wherein as the voltage forming the electric field (with its absolute value being not higher than the glow discharge starting voltage), only a high-frequency AC voltage, or only a low-frequency AC voltage, or a voltage produced by superimposing a high-frequency AC voltage on a low-frequency AC voltage.

7. The film forming method as claimed in claim 6, wherein the high-frequency voltage has a frequency of 1 MHz to 10 GHz and the low-frequency voltage has a frequency less than 1 MHz.

8. The film forming method as claimed in claim 1, wherein the catalyzer is arranged between the base and an electrode for applying the electric field.

9. The film forming method as claimed in claim 8, wherein a gas supply port for leading out the reaction gas is formed in the electrode.

10. The film forming method as claimed in claim 1, wherein the catalyzer and an electrode for applying the electric field are arranged between the base and a reaction gas supply means.

11. The film forming method as claimed in claim 1, wherein the catalyzer or an electrode for applying the electric field is formed in the shape of a coil, wire, mesh, or porous plate.

12. The film forming method as claimed in claim 1, wherein the reactive species are irradiated with charged particles for preventing charging.

13. The film forming method as claimed in claim 12, wherein an electron beam or proton is used as the charged particles.

14. The film forming method as claimed in claim 1, wherein after vapor growth of the predetermined film, the base is taken out of a deposition chamber and a voltage is applied between predetermined electrodes to generate plasma discharge, thereby cleaning the inside of the deposition chamber with the plasma discharge.

15. The film forming method as claimed in claim 1, wherein the vapor growth is carried out under a reduced pressure or a normal pressure.

16. The film forming method as claimed in claim 1, wherein the catalyzer is heated to a temperature within a range of 800 to 2000 C and lower than its melting point, and the reactive species, produced by catalytic reaction or thermal decomposition of at least a part of the reaction gas with the heated catalyzer, are used as material species so as to deposit a thin film by a thermal CVD method on the base heated to the room temperature to 550 C.

17. The film forming method as claimed in claim 16, wherein the catalyzer is heated by its own resistance heating.

18. The film forming method as claimed in claim 1, wherein any one of the following gases (a) to (p) is used as a material gas:

- (a) silicon hydride or its derivative;
- (b) mixture of silicon hydride or its derivative and gas containing hydrogen, oxygen, nitrogen, germanium, carbon, tin, or lead;
- (c) mixture of silicon hydride or its derivative and gas containing impurity made of a group III or group V element of the periodic table;
- (d) mixture of silicon hydride or its derivative, gas containing hydrogen, oxygen, nitrogen, germanium, carbon, tin, or

lead, and gas containing impurity made of a group III or group V element of the periodic table;

(e) aluminum compound gas;

(f) mixture of aluminum compound gas and gas containing hydrogen or oxygen;

(g) indium compound gas;

(h) mixture of indium compound gas and gas containing oxygen;

(i) fluoride gas, chloride gas or organic compound gas of a refractory metal;

(j) mixture of fluoride gas, chloride gas or organic compound gas of a refractory metal and silicon hydride or its derivative;

(k) mixture of titanium chloride and gas containing nitrogen and/or oxygen;

(l) copper compound gas;

(m) mixture of aluminum compound gas, hydrogen or hydrogen compound gas, silicon hydride or its derivative, and/or copper compound gas;

(n) hydrocarbon or its derivative;

(o) mixture of hydrocarbon or its derivative and hydrogen gas; and

(p) organic metal complex, alkoxide.

19. The film forming method as claimed in claim 18, wherein the following thin films and tubular carbon polyhedrons are formed by vapor growth: polycrystal silicon; single-crystal silicon; amorphous silicon; microcrystal silicon; compound semiconductors such as gallium-arsenide, gallium-phosphorus, gallium-indium-phosphorus, gallium-nitride and the like; semiconductor thin films of silicon carbide, silicon-germanium and the like; a diamond thin film; an n-type or p-type carrier impurity-containing diamond thin film; a diamond-like carbon thin film; an insulating thin films of silicon oxide, impurity-containing silicon oxide, silicon nitride, silicon oxynitride, titanium oxide, tantalum oxide, aluminum oxide and the like; oxidative thin films of indium oxide, indium-tin oxide, palladium oxide and the like; metal thin films of refractory metals such as tungsten, molybdenum, titanium, zirconium and the like, conductive nitride metal, copper, aluminum, aluminum-silicon alloy, aluminum-silicon-copper alloy, aluminum-copper alloy and the like; a thin film having a high dielectric constant such as BST and the like; and ferroelectric thin films made of PZT, LPZT, SBT, BIT and the like.

20. The film forming method as claimed in claim 1, wherein the catalyzer is made of at least one type of material selected from the group consisting of tungsten, thoria-containing tungsten, titanium, molybdenum, platinum, palladium, vanadium,

silicon, alumina, ceramics with metal adhered thereto, and silicon carbide.

21. The film forming method as claimed in claim 1, wherein the catalyzer is heated in a hydrogen-based gas atmosphere before supplying the material gas.

22. The film forming method as claimed in claim 1, wherein a thin film is formed for a silicon semiconductor device, a silicon semiconductor integrated circuit device, a silicon-germanium semiconductor device, a silicon-germanium semiconductor integrated circuit device, a compound semiconductor device, a compound semiconductor integrated circuit device, a silicon carbide semiconductor device, a silicon carbide semiconductor integrated circuit device, a high dielectric memory semiconductor device, a ferroelectric memory semiconductor device, a liquid crystal display device, an electroluminescence display device, a plasma display panel (PDP) device, a field emission display (FED) device, a light-emitting polymer display device, a light-emitting diode display device, a CCD area/linear sensor device, a MOS sensor device, or a solar battery device.

23. A film forming apparatus comprising reaction gas supply means, a catalyzer, heating means for the catalyzer, electric field application means for applying an electric field of not

higher than a glow discharge starting voltage, and a susceptor for supporting a base on which a film to be formed.

24. The film forming apparatus as claimed in claim 23, wherein the electric field application means has a power source for applying a DC voltage not higher than the glow discharge starting voltage.

25. The film forming apparatus as claimed in claim 23, wherein the electric field application means has a power source for applying a voltage not higher than the glow discharge starting voltage and produced by superimposing an AC voltage on a DC voltage.

26. The film forming apparatus as claimed in claim 25, wherein the AC voltage is a high-frequency voltage and/or a low-frequency voltage.

27. The film forming apparatus as claimed in claim 26, wherein the high-frequency voltage has a frequency of 1 MHZ to 10 GHz and the low-frequency voltage has a frequency less than 1 MHZ.

28. The film forming apparatus as claimed in claim 23, wherein as the voltage forming the electric field (with its

absolute value being not higher than the glow discharge starting voltage), only a high-frequency AC voltage, or only a low-frequency AC voltage, or a voltage produced by superimposing a high-frequency AC voltage on a low-frequency AC voltage.

29. The film forming apparatus as claimed in claim 28, wherein the high-frequency voltage has a frequency of 1 MHZ to 10 GHZ and the low-frequency voltage has a frequency less than 1 MHZ.

30. The film forming apparatus as claimed in claim 23, wherein the catalyzer is arranged between the base and an electrode for applying the electric field.

31. The film forming apparatus as claimed in claim 30, wherein a gas supply port for leading out the reaction gas is formed in the electrode.

32. The film forming apparatus as claimed in claim 23, wherein the catalyzer and an electrode for applying the electric field are arranged between the base and a reaction gas supply means.

33. The film forming apparatus as claimed in claim 23, wherein the catalyzer or an electrode for applying the electric

field is formed in the shape of a coil, wire, mesh, or porous plate.

34. The film forming apparatus as claimed in claim 23, wherein charged particle irradiation means is arranged near the susceptor.

35. The film forming apparatus as claimed in claim 34, wherein the charged particle irradiation means comprises electron beam irradiation means or proton irradiation means.

36. The film forming apparatus as claimed in claim 23, wherein plasma discharge forming means is provided for applying a voltage between predetermined electrodes to clean the inside of a deposition chamber.

37. The film forming apparatus as claimed in claim 23, wherein the formation of the film is carried out under a reduced pressure or a normal pressure.

38. The film forming apparatus as claimed in claim 23, wherein the catalyzer is heated to a temperature within a range of 800 to 2000 C and lower than its melting point, and the reactive species, produced by catalytic reaction or thermal decomposition of at least a part of the reaction gas with the

heated catalyzer, are used as material species so as to deposit a thin film by a thermal CVD method on the base heated to the room temperature to 550 C.

39. The film forming apparatus as claimed in claim 38, wherein the catalyzer is heated by its own resistance heating.

40. The film forming apparatus as claimed in claim 23, wherein any one of the following gases (a) to (p) is used as a material gas:

(a) silicon hydride or its derivative;

(b) mixture of silicon hydride or its derivative and gas containing hydrogen, oxygen, nitrogen, germanium, carbon, tin, or lead;

(c) mixture of silicon hydride or its derivative and gas containing impurity made of a group III or group V element of the periodic table;

(d) mixture of silicon hydride or its derivative, gas containing hydrogen, oxygen, nitrogen, germanium, carbon, tin, or lead, and gas containing impurity made of a group III or group V element of the periodic table;

(e) aluminum compound gas;

(f) mixture of aluminum compound gas and gas containing hydrogen or oxygen;

(g) indium compound gas;

(h) mixture of indium compound gas and gas containing oxygen;

(i) fluoride gas, chloride gas or organic compound gas of a refractory metal;

(j) mixture of fluoride gas, chloride gas or organic compound gas of a refractory metal and silicon hydride or its derivative;

(k) mixture of titanium chloride and gas containing nitrogen and/or oxygen;

(l) copper compound gas;

(m) mixture of aluminum compound gas, hydrogen or hydrogen compound gas, silicon hydride or its derivative, and/or copper compound gas;

(n) hydrocarbon or its derivative;

(o) mixture of hydrocarbon or its derivative and hydrogen gas; and

(p) organic metal complex, alkoxide.

41. The film forming apparatus as claimed in claim 40, wherein the following thin films and tubular carbon polyhedrons are formed by vapor growth: polycrystal silicon; single-crystal silicon; amorphous silicon; microcrystal silicon; compound semiconductors (gallium-arsenide, gallium-phosphorus, gallium-indium-phosphorus, gallium-nitride and the like); semiconductor thin films of silicon carbide, silicon-germanium and the like; a

diamond thin film; an n-type or p-type carrier impurity-containing diamond thin film; a diamond-like carbon thin film; an insulating thin films of silicon oxide, impurity-containing silicon oxide, silicon nitride, silicon oxynitride, titanium oxide, tantalum oxide, aluminum oxide and the like; oxidative thin films of indium oxide, indium-tin oxide, palladium oxide and the like; metal thin films of refractory metals such as tungsten, molybdenum, titanium, zirconium and the like, conductive nitride metal, copper, aluminum, aluminum-silicon alloy, aluminum-silicon-copper alloy, aluminum-copper alloy and the like; a thin film having a high dielectric constant such as BST and the like; and ferroelectric thin films made of PZT, LPZT, SBT, BIT and the like.

42. The film forming apparatus as claimed in claim 23, wherein the catalyzer is made of at least one type of material selected from the group consisting of tungsten, thorium-containing tungsten, titanium, molybdenum, platinum, palladium, vanadium, silicon, alumina, ceramics with metal adhered thereto, and silicon carbide.

43. The film forming apparatus as claimed in claim 23, wherein the catalyzer is heated in a hydrogen-based gas atmosphere before supplying the material gas.

44. The film forming apparatus as claimed in claim 23, wherein a thin film is formed for a silicon semiconductor device, a silicon semiconductor integrated circuit device, a silicon-germanium semiconductor device, a silicon-germanium semiconductor integrated circuit device, a compound semiconductor device, a compound semiconductor integrated circuit device, a silicon carbide semiconductor device, a silicon carbide semiconductor integrated circuit device, a high dielectric memory semiconductor device, a ferroelectric memory semiconductor device, a liquid crystal display device, an electroluminescence display device, a plasma display panel (PDP) device, a field emission display (FED) device, a light-emitting polymer display device, a light-emitting diode display device, a CCD area/linear sensor device, a MOS sensor device, or a solar battery device.

45. The film forming apparatus as claimed in claim 30, further comprising means for measuring a current flowing between the electrode and the susceptor.